



Philosophical Transactions

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under which lay those before-mention'd Jaw-bone, and Piece of Horn ; which, in all Appearance, to every one that viewed these *Stratums*, had never been removed.

M. C.

Dimensions of the Deers Horns in the Musæum of the
ROYAL SOCIETY.

| | | Feet | Inches. |
|---|-------|------|---------|
| Length of the Skull | - - - | 1 | 4 |
| Breadth of the Forehead | - - - | 0 | 9 |
| Length of each Horn | - - - | 5 | 0 |
| Distance of the extreme Tips of the Horns | | 6 | 0 |

N. B. These Horns (Fig. 2.) are evidently of the same sort as those often found in *Ireland*, of which Descriptions are given in *Transact.* n. 227, n. 394. and n. 414, p. 389. But I do not remember to have met with any before of this Species found in *England*, or any-where else besides *Ireland*.

C. M.

VI. *The Phænomena of Venus, represented in an Orrery made by Mr. James Ferguson, agreeable to the Observations of Seignor Bianchini.*

Read March 20. 1745-6. *I*N all the Orreries that I have here printed with Alterations.

seen, *Venus* is represented as having her *Axis* perpendicular to the Plane of the Ecliptic, and her diurnal Motion thereon equal to 23 Hours of our terrestrial Time. Hence, as her annual Motion is performed in about 225 of our Days, it will contain 234 of hers ; consequently, to an Eye placed in *Venus*, the Sun will always appear to go

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thro' a Sign of the Zodiac in $19\frac{1}{2}$ of her Days; and as her *Axis* has no Inclination, she must have a continual Equality of her Days and Nights, without any Variation of Seasons, and so her annual Motion can be of no other Use than to keep her from falling down to the Sun.

But *Bianchini* gives a very different Account of her; which is, that her *Axis* inclines 75 Degrees from a Line supposed to be drawn perpendicular to the Plane of the Ecliptic (by which I suppose he means her own Ecliptic, and not the Earth's); and that her diurnal Motion is performed in 24 Days and 8 Hours of our Time; and this will cause her Year, which is equal to almost 225 of our Days, to contain only $9\frac{1}{4}$ of her Days; and this odd Quarter of a Day in *Venus* will make every fourth Year a Leap Year to her, as happens to us on Earth, by the 6 Hours that our Year contains above 365 Days: And to her the Sun will appear always to go thro' a Sign of the Zodiac in little more than $\frac{3}{4}$ of her Day, which is equal to $18\frac{1}{4}$ of our Days; and in going round the Sun, her North Pole constantly leans towards the 20th Degree of *Aquarius*.

Thus, with regard to the absolute Length of *Venus's* Year, *Bianchini* agrees with *Cassini* and other Astronomers: but differs widely in other very remarkable Particulars, from which arise so many Advantages, as to make that Planet incomparably more fit for its Inhabitants, than we could possibly conceive it to be by a quick Rotation on an *Axis* perpendicular to its annual Path. For *Venus* is so much nearer the Sun than our Earth is, that it is well known she must have twice as much Light and Heat as our Earth has;
and

and^d then, was the Sun always perpendicularly above her Equator, we cannot imagine but that her Equatorial Parts must be burnt up with Heat, and her Polar Parts uninhabitable, by reason of the Greatness of Cold, occasioned by the Sun-beams being parallel to, or making so very acute Angles with, the Horizon.

But, by such a Motion as *Bianchini* describes, and which I have exactly represented in my Orrery, these Inconveniences are avoided ; for there is no Place in *Venus* but what will have the four Seasons every Year, and the heated Places will have Time to cool ; because, to any Place over which the Sun passes vertically on any given Day, he will, on the next Day, be 26 Degrees from the *Vertex* thereof, even tho' the Place be on the Tropic ; and if it be on the Equator, One Day's Declination will remove him $37\frac{1}{2}$ Degrees from it.

I having considered in general what the Effects of the Sun's quick and great Declination would be in *Venus*, as occasioned by the great Inclination of her *Axis*, with her slow diurnal and quick annual Motion ; and finding that her Globe in the Orrery, by being not quite an Inch in Diameter, was insufficient for solving her *Phænomena* to any Degree of Exactness ; I took the following Method, by which I could do it mechanically, to serve my Purpose.

Along the Middle of a strait narrow Slip of Parchment I drew a black Line, and then measuring my Parchment round a common Globe of 9 Inches Diameter, cutting it so as when the Ends were a little overlapp'd, it would become a Girdle, and stick fast on any great Circle of the Globe. Having thus fit-

red it, I took it off; and laying it flat on a Table, I divided one Side of the black Line into $9\frac{1}{4}$ equal Parts for the 9 Days and Quarter of a Day in *Venus's* Year, and then I subdivided each Day into 24 Hours or equal Parts, of which the odd Quarter contained 6, and set the proper Figures to them. The other Side of the Line I divided into 12 equal Parts or Signs, and each Sign into 30 Degrees: By this means I could easily see, at every Day and Hour in *Venus*, in what Place of the Ecliptic the Sun was: And putting this Girdle round the Globe, at an Angle of 75 Degrees to the Equator, crossing it in two opposite Points, it would, by representing *Venus's* Ecliptic drawn on her Globe, serve for the Solution of Problems concerning her, as the Ecliptic on our terrestrial Globe does for those relating to our Earth: For, by bringing the Sun's Place, at any Day or Hour, to the brazen Meridian, I had thereby his Declination for that time; which gave me both an easy and sure Way for drawing the Spiral of the Sun's Motion over the Body of *Venus* on this Globe; and then, by elevating it to different Latitudes, I could immediately see where the Spirals cut the Horizon in any Latitude, and at what Height or Declination they cross'd the Meridian; as by the Hour-Circle I could easily perceive the Times of the Sun's Rising and Setting, and his Amplitudes on the Horizon; and I called that the first Meridian, which pass'd thro' the Northern Tropic, in the Place where the Sun touch'd it at his greatest North Declination; reckoning the East or West Longitudes on the Equator from that Meridian. But this Meridian will only serve for One Year; because, as the odd Quarter of a Day in *Venus* causes the Sun to cross her

her Equator 90 Degrees Westward of the former Place every Year, the Place of the Sun's greatest Declination at the North Tropic will be in a Meridian 90 Degrees Westward of the former also. Things being thus premis'd in general : I now proceed to give as good a Description as I can of the particular *Phænomena* in *Venus*, confining myself chiefly to what happens in her Northern Hemisphere ; knowing that the same must happen, *mutatis mutandis*, in the Southern.

1. Her *Axis* is inclined $51\frac{1}{2}$ Degrees more than the *Axis* of our Earth, and therefore the Variation of her Seasons will be much greater than of ours.

2. Because her North Pole inclines toward *Aquarius*, and ours to *Cancer* ; her Northern Parts will have Summer in the Signs where those of our Earth have Winter ; and *vice versa*.

3. The artificial Day at each of her Poles (containing $4\frac{1}{8}$ apparent diurnal Revolutions of the Sun) will be equal to $112\frac{1}{2}$ natural Days on our Earth.

4. The Sun's greatest Declination, on each Side of her Equator, amounts to 75 Degrees : Therefore her Tropics are only 15 Degrees from her Poles, and her Polar Circles at the same Distance from her Equator. Consequently, her Tropics are between her Polar Circles and Poles, contrary to what those on our Earth are.

6. The Sun, in one apparent diurnal Revolution from the Equator, and any Meridian where he crosses it, to the same Meridian again, changes his Declination at least 14 Degrees more on *Venus*, than on our Earth from the Equinox to the Solstice.

6. Let us now suppose an Inhabitant standing on her North Pole, where the Sun's Declination is always the same with his Altitude, and looking toward that Point of the Horizon where the first Meridian (above-mentioned) cuts it; and let him call that Point the South, so shall he have a Meridian fixt, which will determine the other cardinal Points on the Horizon; tho', strictly speaking, every Point of the Horizon to him is South: Yet, for once, let us suppose him to have an horizontal Plane, fixed with its South Point in this Meridian, and thence divided and numbered like the Horizon of a Globe: Put a moveable Ruler with Sights to turn round the Centre of this Plane, for observing the Sun's Amplitude at Rising and Setting; and a graduated Quadrant to be fixed in the North and South Line, with a moveable Index, for taking the Sun's Altitude, in passing over the Meridian. The same Degree, or Part of a Degree, that gives him the Altitude, will also give him its Declination, and he will have the following *Phænomena*.

The Sun will rise $22\frac{1}{2}$ Degrees North of the East, and going on $112\frac{1}{2}$ Degrees, as measured on the horizontal Plane, he will cross the Meridian at an Altitude of $12\frac{1}{2}$ Degrees; then, making an intire Revolution without setting, he will cross it again at an Altitude of $48\frac{1}{2}$ Degrees: At the next Revolution he will cross it as he culminates, at the Height of 75 Degrees, being only 15 Degrees from the *Zenith*; and thence he will descend in the like spiral manner, crossing the Meridian first at an Altitude of $48\frac{1}{2}$ Degrees; then, at an Altitude of $12\frac{1}{2}$ Degrees, and going on thence $112\frac{1}{2}$ Degrees he will set $22\frac{1}{2}$ Degrees North of the West, having been 4 Revolutions and $\frac{1}{2}$ Parts of One above the Horizon.

7. If the Spectator turns his Instrument $22\frac{1}{2}$ Degrees toward the East, and then supposes his Quadrant in the Plane a new Meridian to him; the Sun will then rise due East, and set in the North-West; and his Declination in the Meridian will not be the same as before; for he will first cross it at an Altitude of 10 Degrees: next of 46; then, of $74\frac{6}{8}$; and, at an Hour and an half after, he will come to his greatest Declination; from which, in his Descent, he will not cross the Meridian in the same Degrees of Altitude, as in ascending he did.

8. Now, let the Spectator turn his Instrument 90 Degrees still more toward the East, and the Sun will rise due South; and from thence making a complete Revolution, he will cross the Meridian at an Altitude of $37\frac{1}{2}$ Degrees; making another Revolution, he will cross it at an Altitude of $70\frac{3}{4}$ Degrees; and, going on $7\frac{1}{2}$ Hours (or 112 Degrees) he comes to his greatest Declination in the West-North-West: Thence descending, at the End of the third Revolution he crosses the Meridian $58\frac{1}{3}$ Degrees high; at the End of the fourth he crosses it in $23\frac{3}{4}$ Degrees of Altitude; and, going on thence 225 Degrees, or $\frac{5}{8}$ of a Revolution, he sets in the North-East,

9. If the Spectator will now turn his Instrument just half round, shifting his Meridian 180 Degrees, the Sun will rise in the North; and, going on 180 Degrees, or half a Revolution, he will cross the Meridian at an Altitude of 19 Degrees; then, making a complete Revolution, he will cross it at an Altitude of 55 Degrees; and, going on thence $292\frac{1}{2}$ Degrees he comes to his greatest Declination in the East-South-East; from which Place he descends, crossing the Meridian in $73\frac{1}{2}$ Degrees of Altitude; and, in the next Revolution, he crosses the

Meridian at an Altitude of $41\frac{1}{2}$ Degrees: At the fourth Revolution he crosses it at an Altitude of 5 Degrees; and going on thence 45 Degrees, or $\frac{1}{8}$ of a Revolution, he sets in the South-West.

10. The Sun being thus for half a Year together above each Pole of *Venus* in its Turn, will cause the whole Year at her Poles, as well as at the Poles of our Earth, to contain only one Day and one Night: But there, the Difference between the Heat in Summer and Cold in Winter (or of Mid-day and Midnight) is greater than betwixt the same on any two Places of our Earth; because, in *Venus*, the Sun is for half a Year together above the Horizon of one or other of the Poles; and for at least $\frac{2}{3}$ of a Revolution (or about 16 of our Days) within 20 Degrees of the *Zenith*; and during the other Half of the Year, always below the Horizon; and for a considerable Part of that Time, at least 70 Degrees from it: Whereas at the Poles of our Earth, tho' the Sun is for half a Year together above the Horizon, yet his Altitude is never more than $23\frac{1}{2}$ Degrees above it in Summer, nor his Depression greater than that Quantity below it in Winter. When the Sun is in the Equator, he is seen in the Horizon of both Poles; one Half of his Disc above, and the other below: And descending quite below the Horizon of one Pole, he ascends in a visible Spiral above that of the other, until he comes within 16 Degrees of the *Zenith*, where he keeps the same Altitude nearly for some time; then descends in the like spiral manner, till he gets below the Horizon, where he continues invisible for the other Half of the Year. This will occasion to each Pole one Spring, one Harvest, a Summer as long as them both,
and

and one Winter, equal in Length to the other three Seasons.

The Sun's great Distance below the Horizon of *Venus's* Poles, will make her Winters much more uncomfortable than at the Poles of our Earth, where they have Twilight more than half the Winter-time; unless she be surrounded with an Atmosphere capable of occasioning a Twilight, at least as long in proportion to her Winter, as our Twilight is to ours. But this can hardly be suppos'd; because always, when we see *Venus*, she appears with the same constant Serenity; and therefore I am apt to believe she has a Satellite, to supply, in some measure, the Absence of the Sun; as our Moon does to our Earth's Poles, for one Half of the Winter constantly, without setting, from the first to the third Quarter. 'Tis true, that we are inconveniently posited, with regard to *Venus* for seeing her Satellite (if she has one); because, when her Moon or Satellite has its enlighten'd Side toward us, it may be too far distant to be seen, because *Venus* is then beyond the Sun, and, consequently, furthest from us; and when she is betwixt us and the Sun, or thereabouts, her full Moon would have its dark Side to us: And tho' *Venus* be then nearest the Earth, yet her Satellite could no more be seen by us, than we can see our own Moon at her Conjunction. When *Venus* is at her greatest Elongation, we should have only one Half of the enlighten'd Side of her full Moon turn'd towards us; and even then, perhaps, on account of its Smallness, it may be too far distant to be seen by our Telescopes. But of this only by-the-bye.

11. At the Tropics, the Sun in Summer will continue for about 15 of our Weeks together above the
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Horizon

Horizon without setting, and as long below it in Winter without rising. While he is more than 15 Degrees from the Equator, he neither sets to the Inhabitants of the nearest Tropic, nor sets to those of the other; whereas, at our terrestrial Tropics, he rises and sets every Day in the Year. But to let us know more particularly the *Phanomena* of *Venus's* Tropics, we will suppose the Inhabitant, who has seen the above-mention'd Appearances at the North Pole, to have travell'd thence along the first Meridian 15 Degrees to the Northern Tropic, carrying his Engine or Instrument along with him; and to have set it due North and South, in the Place where the said Meridian intersects the Tropic; and as the Meridian of every Place is in a great Circle passing thro' the *Zenith* of the Place and both Poles, he can now be at no Loss how to settle his Meridian, and observe as well the Amplitude and Azimuth, as the Altitude of the Sun; who will rise to him 10 Degrees North of the East, with about one Degree of North Declination: And going on 100 Degrees (to be measured on the horizontal Plane) he will cross the Meridian with $12\frac{1}{2}$ Degrees of North Declination, and $27\frac{1}{2}$ of Altitude; then, making an intire Revolution without setting, he will cross the Meridian at $48\frac{1}{2}$ Degrees of Declination, and $63\frac{1}{2}$ of Altitude: At the End of the next Revolution, he will cross the Meridian in the *Zenith* at the greatest Declination; namely, 75 Degrees; and thence he descends in the like Spiral, crossing the Meridian at the same Altitudes as above, till, in his fifth Revolution, he sets 10 Degrees North of the West.

12. Let our Traveller now remove Westward on the same Tropic, to a Meridian $97\frac{1}{2}$ Degrees distant from the first; and there he will have very great Differences of the Rising, Setting, and Meridian Altitude of the Sun; which will now rise to him the first time, in the South Point of his Horizon, at 12 o'Clock; at 1 o'Clock he will be about half a Degree above the Horizon, and will set at 2 o'Clock: So this short artificial Day in *Venus* (which is somewhat longer than two natural Days on our Earth) will have no Forenoon at all. The Sun, after continuing almost 14 of *Venus's* Hours below the Horizon, supposing each diurnal Rotation to be divided into 24 Hours, will rise a little before 4 o'Clock next Morning, near the North-East; and, going on 130 Degrees, he will then cross the Meridian with 22 Degrees of North Declination, and 37 of Altitude: Then, going on without setting, he again crosses the Meridian at 57 Degrees of Declination, and 72 of Altitude; and advancing forward thence $17\frac{1}{2}$ Hours, or $262\frac{1}{2}$ Degrees, he comes to his greatest Declination, $7\frac{1}{2}$ Degrees to the North of the East: From thence, completing his Revolution to the Meridian, he now crosses it in $71\frac{1}{2}$ Degrees of Declination, being only $3\frac{1}{2}$ Degrees from the *Zenith*: At the next Revolution he crosses the Meridian with $38\frac{1}{2}$ Degrees Declination, and $53\frac{1}{2}$ of Altitude: At the next, which is the fourth Revolution, he crosses the Meridian with $1\frac{1}{2}$ Degree of Declination, and $16\frac{1}{2}$ Degrees of Altitude; and then goes on 65 Degrees, and sets near the West-South-West.

13. Suppose now that our Traveller removes still further Westward, on the same Tropic, to a Meri-

dian 105 Degrees distant from this his second Station and then the Sun will first rise to him in the South East about 9 o'Clock; and going on thence 45 Degrees, he will cross the Meridian with 6 Degrees of South Declination, and 9 of Altitude, at 12: About 2 o'Clock he will be a Degree higher; and, thence descending, he will set near the North West a little before 9 o'Clock: So the Afternoon of this Day is almost 6 Hours (about 6 natural Days with us) longer than the Forenoon; and its Night is but little more than 3 Hours long: For the Sun, after going a little below the Horizon, rises in the North Point thereof; and, making half a Revolution, he crosses the Meridian with 33 Degrees of Declination, and 48 of Altitude; thence, making a whole Revolution, he crosses the Meridian at 66 Degrees of Declination, and 81 of Altitude: At the next Revolution his Declination is 63 Degrees (having passed the greatest 14 Hours before): At the next, it is 28 Degrees of Declination; and, going on thence about 146 Degrees, he sets North West-by-North, about half an Hour after 9 o'Clock; and continues invisible till 3 Quarters past 5 in the next Morning, when he rises about 4 Degrees North of the East; and, going thence forward 94 Degrees, he crosses the Meridian about 5 Degrees Altitude, and 10 of South Declination, having kept the same Altitude very nearly for three Hours; then descending, he sets in the South-South-West, about half an Hour past 1 o'Clock; which makes the Afternoon 5 Hours and about 12 Minutes shorter than the Forenoon of the same Day. The Sun now sets for about 15 of our Weeks to *Venus's* Northern Tropic, and rises to the Southern; in which the

Phænomena are the same: Each Tropic having the four Seasons once every Year; the Winters being longer than the Summers, tho' not quite so long, in proportion, as at the Poles.

14. Having said so much concerning the North Pole and Tropic, proceed we now to station our Inhabitant in a Place of 45 Degrees of North Latitude, where the first Meridian cuts the Parallel, and he will have the following *Phænomena*.

The Sun will rise 43 Degrees East of the South, a little before 9 o' Clock; and, ascending very quickly, he will, in little more than 3 Hours, cross the Meridian at an Altitude of 19 Degrees, with 26 Degrees of South Declination; then going on 62 Degrees, he will set near the West-South-West about 5 o' Clock in the Afternoon; by which means it is almost two Hours longer than the Fore-noon; each Hour in *Venus* being equal in Length to 24 Hours and 20 Minutes of our terrestrial Time. The next Day the Sun will rise 3 Degrees North of the East, about half an Hour past 5 o' Clock in the Morning, and will cross the Meridian with $12\frac{1}{2}$ Degrees of North Declination, and $57\frac{1}{2}$ of Altitude; and will set in the North-West-by-West, about half an Hour past 7 o' Clock: So that the Afternoon will be 2 Hours longer than the Forenoon. The next Day the Sun rises 53 Degrees North of the East, about 3 o' Clock; and will cross the Meridian $3\frac{1}{2}$ Degrees North of the *Zenith*; or with $86\frac{1}{2}$ Degrees of North Altitude, and $48\frac{1}{2}$ of Declination: Then he goes round without Setting; and crosses the Meridian 30 Degrees North of the *Zenith*, where he comes to his greatest Declination; from which he returns in the like Spiral toward the Equator,

Equator, and beyond it; but will not rise and set at the same Hours as before: For, having made a Revolution without Setting, in the next he sets 53 Degrees North of the West, about 9 o'Clock: Next Morning he rises in the North-East-by-East, about half an Hour past 4 o'Clock; crosses the Meridian with $12\frac{1}{2}$ Degrees of Declination, and sets 3 Degrees North of the West, about half an Hour past 6; and now the Forenoon is 2 Hours longer than the Afternoon. The next Day the Sun rises about 7 o'Clock, 62 Degrees East of the South; passes over the Meridian at an Altitude of 19 Degrees, with 26 Degrees of South Declination; and sets a little after 3 o'Clock; which makes the Forenoon to be about 2 Hours at least longer than the Afternoon: And now the Sun will continue below the Horizon at least 12 of our Weeks without rising to this Inhabitant of *Venus*.

15. In this Place of *Venus* the Hour and Amplitude of the Sun's Rising, for one Half of the Year, are the same with those of his Setting in the other Half; which will also happen in all Places under the first Meridian, where he rises and sets: But, if our Spectator pleases to remove along the Parallel of 45 Degrees Latitude, Eastward 142 Degrees, the *Phænomena* of Things will then be very different to him; for the Sun once from rising in the North-East-by-East, will pass over the Meridian with $3\frac{1}{2}$ Degrees of North Declination, and set due North; which will make the Afternoon somewhat above four Hours longer than the Forenoon; and the next Morning the Sun will rise at 2 o'Clock, $21\frac{1}{2}$ Degrees East of the North, or about the North-North-East. As to what would happen on the other Days concerning
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the Sun's Rising and, I shall not take any further Notice of it; but, if the Inhabitant will travel Eastward $37\frac{1}{2}$ Degrees, still upon the same Parallel of Latitude, he will see the Sun, at making his first Appearance from the Southern Tropic, rise due South at 12 o' Clock; and, getting about half a Degree above the Horizon, when he has gone forward about 9 Degrees, he will then descend, and set about a Quarter after 1: So there is only an Hour and a Quarter in the first Day of the Sun's Appearance; and the second Day will be 11 Hours long; but the third Day will be about 87 Hours long; for the Sun will make 3 Revolutions and somewhat more than an half without setting: The fourth Day will be 11 Hours long; and the fifth will only contain an Hour and a Quarter; for the Sun will rise about 18 Degrees East of the South, and set in the South Point of the Horizon.

16. We will now suppose that the Spectator has travelled from 45 Degrees of North Latitude, to the Equator, and has a Mind to take a Tour round the same, because the *Phænomena* will be very different in different Parts thereof; tho' the Sun will rise and set to every Part of it, in every apparent Revolution; but we shall only consider in general what happens at two Places thereof: The first Place shall be that, where the first Meridian crosses the Equator; and the second, a Place $112\frac{1}{2}$ Degrees Westward of the first. To each of these Places the Sun will always rise at 6, and set at 6, tho' sometimes his Meridian Altitude may be 11 Degrees more or less than his Midnight Depression; and in other Places the Difference will amount to 15 or 16 Degrees; so that, if the diurnal and
nocturnal

nocturnal Spirals of the Sun's Motion on the Body of this Planet were measured, the one would very much exceed the other. To the first of these two Places the Sun will rise 74 Degrees South of the East in coming from the Southern Tropic, and set $61\frac{1}{2}$ South of the West, having been 22 Degrees high at Mid-day, and will be $32\frac{1}{2}$ depress'd below the Horizon at Midnight. The next Day he will rise 44 Degrees South of the East, and set 26 Degrees South of the West; having been 55 Degrees high at Noon, and will be $74\frac{1}{2}$ depress'd at Midnight. The third Day he will rise $7\frac{1}{2}$ Degrees South of the East; and crossing the Equator at half an Hour after 10 o' Clock, he will, in $7\frac{1}{2}$ Hours after, set 12 Degrees North of the West; and so proceed, changing his rising and setting Amplitude every Day, in advancing toward the Northern Tropic, till he reaches it; and then his setting Amplitude, in going from it, will be the same as his rising Amplitude in coming toward it. In the second Place, all I shall take notice of, is, that the Sun, in coming from the Southern to the Northern Tropic, will cross the Equator at 9 o'Clock at Night; and, in going from the Northern to the Southern Tropic, he will cross the Equator at Mid-day.

17. At the Equator the Sun's Rays will be as oblique, when his Declination is greatest, as they are at *London*, when he touches the Tropic of *Capricorn* in *December*; because the Tropics of *Venus* are as far from each Side of her Equator, as the Tropic of *Capricorn* is from the Parallel of *London* on our Earth: Therefore, at *Venus's* Equator, there will be two Winters, two Springs, two Summers, and two Autumns, every Year:

Year: And because the Sun stays for some time near the Tropics, and passes so quickly over the Equator, every Winter there will be about twice as long as Summer: But, because of the quick Return of Summers, and the general Heat on the Body of *Venus*, the Winters there will be very mild; and so will make the Equator, and all Places thereabouts, very temperate, and fit for Habitation.

18. Those Parts of *Venus* which lie between the Poles and Tropics, and between the Tropics and polar Circles, and also between the Polar Circles and Equator, will more or less participate of the *Phænomena* of these Circles, as they are more or less distant from them.

19. The Places of the Equinoxes and Solstices on the Body of *Venus* go backward, or from East toward the West, 90 Degrees every Year, This is not occasioned by any Mutation of her *Axis* from its Parallelism; but by the Sun's being a Quarter of a Day later in crossing the Equator every Year, than on the Year before; and therefore he will cross it in a Place 90 Degrees Westward of the former every Year: So that to any Place where he crosses the Equator at Noon, he will, on the Return of that Day at Noon in the next Year, be almost 10 Degrees South of the Equator, and will cross it at 6 in the Evening; supposing the Year to begin when the Sun is on the Equator, in passing from the Southern Tropic to the Northern. Hence, tho' the Spiral, in which the Sun's apparent Motion is performed, be of the same Sort every Year, yet it will not be the very same; because the Sun will pass vertically over all the same Places but once in every four Years: And, in the above Description, I

have only shewn what will happen in general, for one Year; having only drawn the Spiral of the Sun's Motion for that Time: And if a Spectator, on any Parallel of Latitude, should want to see the same Appearances of the Sun's Rising and Setting every Year, and, consequently, to have the particular Days thereof to be still of the same Length with those of the Year, he must travel Westward every Year 90 Degrees on the same Parallel.

20. The Inhabitants of *Venus* will be very careful in adding a Day to some particular Part of every fourth Year, to keep still the same Seasons to the same Times; because, as the great annual Change of the Equinoxes and Solstices will shift the Seasons forward a Quarter of a Day every Year, they would, in 36 Years, shift the Seasons forward thro' all the Days of the Year: But, by this intercalary Day, every fourth Year will be a Leap-Year; which will bring her Time to an even Reckoning, and keep her Calendar right.

21. The great Change of the Sun's Declination every Day, which causes his Altitude, at Noon, or any other Hour, and his Amplitude at Rising and Setting, to be so very different in Places lying under the same Parallels of Latitude, will be of one singular Use in *Venus*, the like whereof we shall never enjoy on the Earth; and that is no less than the giving a sure and easy Method of finding the Longitude. For, suppose to one Place, at Noon, the Sun's Declination is 30 Degrees, and to another Place it is, only 20 Degrees 35 Minutes at Noon, in the same revolutionary Spiral, going from the Equator toward the Northern Tropic; the Difference of these two Declinations is 9 Degrees 25 Minutes: In the same
Spiral

Spiral from the Equator, where any Meridian crosses it, to the same Meridian again, the Declination changes from nothing to 37 Degrees 21 Minutes; and the Sun has gone 38 Degrees 55 Minutes in the Ecliptic. These Things being known, the Proportion will be thus; As 75 Degrees, the greatest Declination, is to the Sun's Motion in that Time, which is 3 Signs, equal to $2\frac{5}{16}$ Revolutions round *Venus*; so is 9 Degrees 25 Minutes (the Difference of Declination at two given Places) to 9 Degrees 44 Minutes, which is a fourth Part of a Revolution; and therefore the one Place is a fourth Part of a Circle, or 90 Degrees of Longitude distant from the other: And, as the Declination was advancing from the Equator toward the Northern Tropic, the Place, in whose Meridian it was 20 Degrees 35 Minutes, is Eastward from the Place in whose Meridian it was 30 Degrees, supposing them both to be in the Northern Hemisphere.

I should be very glad to see this Description examined into, and put in a better Form, by some whose Abilities are much greater than mine: And altho' it seems strange, at the first View, that the great Inclination of *Venus's Axis*, with her slow diurnal and quick annual Motion, should make such mighty Differences of her *Phænomena* from the Earth's; yet I verily believe, that, was the Spiral of the Sun's Motion for four Years, which would contain 37 Revolutions, nicely drawn on a large Globe, and the Times mentioned in which the Sun would rise and set, with his different Amplitudes, Altitudes, and Declinations, where the Effects thereof would differ considerably in many particular Parts of each Spiral;

and so occasion remarkable Differences of the Lengths of Day and Night, in the same Revolutions, to Places under the same Parallels of Latitude; a whole Volume might be wrote in the Description, if the Author would descend to Particulars.

VII. *A Machine for sounding the Sea at any Depth, or in any Part, invented by Major Wm. Cock in the Year 1738. in a Voyage to Georgia.*

Presented April 10. 1746. **T**HE Draught of this Machine is exhibited in TAB. II. Fig. 1.

wherein

AAAA represent a Trunk of Timber, with a square Hollow, thro' the Centre of which passes the square Piece of Timber *BB*.

A Groove on each Side, in which are placed the two Pieces of Iron *CC*; the Foot of each resting on the Pins *DD*, that pass thro' the Trunk; the upper Part of the Irons are hooked to an iron Pin at *E*, which passes thro' the square Piece *BB*; which Piece is hollowed between *H* and *H*, for the Hooks of the Irons *CC* to pass up and down.

When the Weight *F* touches the Ground, the two Irons *CC* sink the Trunk to *G*, which unhooks them at *E*; whereupon they fall off, and leave the Trunk at Liberty to float or rise up again to the Surface.

A Machine of these Dimensions, loaded with an iron Ball, *F*, of 12 Pounds Weight, being let down
in